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The epidemiology of paediatric supracondylar fracture fixation: A population-based study

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ABSTRACT

Introduction: The epidemiology of paediatric supracondylar fracture (SCF) fixation has not been evaluated at a population level. The purpose of this study was to: (1) determine the incidence density rate (IDR) of SCF fixation and (2) determine the rate of and risk factors for re-operation.
Methods: Using administrative databases, all patients who underwent SCF fixation (closed reduction percutaneous pinning (CRPP) or open reduction (OR)) in Ontario between April 2002 and March 2010 were identified. Exclusion criteria included age (>12 years), a prior or concurrent non-SCF elbow fracture or previous humeral osteotomy. The overall IDR of SCF fixation and for subgroups of age, sex and season were calculated. A multivariate regression (immediate and short-term re-operation) and a Cox proportional hazards model (long-term re-operation) were used to identify patient, injury and provider factors that influenced re-operation risk and were reported as odds ratios or hazard ratios (HRs) with 95% confidence intervals (CIs), respectively.
Results: A total of 3235 patients with a median age of 6.0 years (interquartile range (IQR): 3.0) underwent SCF fixation. The median follow-up was 6.0 years (IQR: 3.7). The majority underwent a CRPP (78.7%) which were performed after hours (75.6%). The overall IDR was 20.7/100,000 person-years (py), but it varied significantly by season and age. Re-operation was uncommon in the immediate (1.0%), short-term (1.4%) and long-term (0.3%) follow-up period. As compared to CRPP, patients who underwent OR were more likely to undergo early nerve exploration (odds ratio: 7.8 (CI: 3.0–20.6)) and re-operation in the long term (HR: 3.0 (CI: 1.0–8.7)). Increased surgeon volume of SCF fixation was protective against repeat fixation (odds ratio: 0.9 (CI: 0.9–1.0)) and re-operation in the long term (HR: 0.9 (CI: 0.8–1.0)).
Conclusions: While SCF fixation is common, the rate of re-operation is low. No differences existed between the sexes and a higher volume of fixations occurred during the summer months.

Introduction

Supracondylar fractures (SCFs) of the distal humerus are the most common elbow fracture in children and account for approximately 12–17% of all paediatric fractures [1–5]. Controversies with respect to treatment, including the indications for operative versus non-operative treatment, closed reduction percutaneous pinning (CRPP) versus open reduction (OR) and time of surgery (day vs. after hours, and immediate vs. delayed) exist [2,6–10].

CRPP is the most commonly used treatment for displaced SCF [2,8,9]. Open reduction with percutaneous pinning (ORPP) is generally indicated when CRPP attempts have failed, if the limb is dysvascular or if a fracture is open [2,6,8,9]. Both fixation methods however, carry risks and complications including: pin track infections (~0–17%) [11–15], vascular injury (~0–3%) [16], iatrogenic nerve injury (~0–5%) [6,9,11,13,14,17], cubitus malunion (~1–10%) [9,11,18] and loss of fixation (~3–10%) [9,10,13].

Despite its incidence, the epidemiology of paediatric SCF fixation has not been evaluated at a population level. In this population-based study, our purpose was to: (1) determine the incidence density rate (IDR) of SCF fixation and (2) determine the

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rate of and risk factors for re-operation. Research ethics approval was obtained prior to the commencement of the study.

Materials and methods

Study design

Data for this retrospective population cohort study were obtained from administrative databases through the Institute for Clinical Evaluative Sciences (ICES, www.ices.on.ca). Diagnostic and procedural details were obtained using anonymous linkage to the Discharge Abstracts Database (DAD) or Same Day Surgery (SDS) databases administered by the Canadian Institute for Health Information (CIHI) and through the use of 'International Classification of Diseases and Related Health Problems, 9th/10th edition' (ICD-9/10) diagnosis codes. The Registered Persons Database (RPD) was used to obtain baseline demographic information for each patient at the time of the index procedure. The date of the index procedure served as the date of cohort entry.

Inclusion and exclusion criteria

Ontario Health Insurance Plan (OHIP) physician fee codes (Appendix I) were used to identify all patients who underwent operative fixation of an SCF in the province of Ontario between 1 April 2002 and 31 March 2010. In the public health-care system of Ontario, OHIP provides >95% of all surgical services [19]. Exclusion criteria included age >12 years, non-Ontario residents and patients missing baseline demographics. Patients with elbow fracture(s) or humeral osteotomy in the past 2 years were also excluded (Table 1). The population cohort was followed until study termination (1 April 2012), allowing for a minimum of 2-year follow-up.

Covariates

Patient

Baseline characteristics included age, sex and income quintile. Income quintile (Q1 (lowest) to Q5 (highest)), a surrogate for socioeconomic status, was calculated using Statistics Canada data to generate estimates of the median income of each patient's home neighbourhood [20,21]. Postal codes were also used to categorize each patient's residence as 'urban' or 'rural' [20,22]. The length of hospital stay after the index procedure was defined as the difference from the discharge date to the date of the index procedure.

Injury

Patients were dichotomised according to procedure: (a) CRPP or (b) OR. A specific OHIP billing code for percutaneous pinning (PP) with OR does not exist currently in the OHIP-Physician's Schedule of Benefits. Given the age of patients included in this study, we have assumed that all cases of SCF OR were performed with PP rather than with plate fixation.

Table 1
Cohort development.

Cohort size (pre exclusion)	5188
Exclusion criteria	
Age > 12	1099
Non-Ontario resident or Missing demographic data	21
Multiple index billing dates	58
Prior supracondylar or epicondyle fracture	765
Prior condyle fracture or humeral osteotomy	10
Cohort size (post exclusion)	3235

Concurrent procedures at the time of the index event were also identified, including irrigation and debridement (I&D) of 'open' SCF and radius and/or ulna closed reduction (CR) or OR. Due to database limitations, side of surgery for the index event and subsequent re-operation(s) could not be determined.

Provider

Provider factors included surgeon volume, surgeon years in practice, time of surgery and hospital academic status. Surgeon volume was defined as the mean number of CRPP procedures performed in the previous calendar year by the primary billing surgeon. The number of years in practice was defined as the difference between the year of subspeciality certification in orthopaedic surgery from the Royal College of Physicians and Surgeons of Canada (RCPSC) and the year of the index procedure.

Timing of surgery was recorded as either 'day' surgery (performed between the hours of 07:00 and 17:00 on weekdays) or 'after-hours' surgery (performed between the hours of 17:00 and 07:00 on weekdays or anytime on weekends and holidays) (Appendix I). Hospital status (academic vs. non-academic) was determined by membership to the Council of Academic Hospitals of Ontario [21,22].

Re-operation

Immediate

Immediate re-operations were defined as those undertaken within 7 days of the index event and included forearm fasciotomy or nerve exploration.

Short term

Short-term re-operations were defined as those undertaken between 1 and 6 weeks of the index event and included I&D or repeat fixation.

Long term

Long-term re-operations were defined as those undertaken >6 weeks of the index event (ending at study termination) and included humeral osteotomy or ulnar nerve decompression. Given the known low incidence of these re-operations [2,6,9,10], a composite long-term re-operation rate (humeral osteotomy and ulnar nerve decompression) was evaluated.

Privacy restrictions

Due to privacy restrictions and the data sharing agreements previously held between ICES and the Ontario Ministry of Health and Long-Term Care, any outcome containing ≤5 patients was suppressed to protect patient confidentiality.

Data analysis

Two-tailed Student's *t*-tests were used to compare continuous variables, while the chi-squared test and the Cochran–Armitage test for trends were used to compare categorical variables [23]. IDR (100,000 person-years (py)) was calculated by comparing all patients who underwent SCF fixation to all eligible Ontario persons (by age) [23]. The overall IDR was the mean of all individual yearly IDRs. Data from a single study year (2007) were used to calculate the IDR of each demographic subgroup, including age (categorized as 0–4, 5–8 and 9–12 years), gender (male and female) and season (summer (April–September) and winter (October–March)) [23]. Data from 2007 were used as they closely approximated the mean overall IDR. IDRs were compared between demographic subgroups via IDR ratios (IDRR) using a Poisson model to test for statistical significance [23].